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Comment

## ***Interactive comment on “Relevance of a kite-based calibration for a water vapour Raman lidar” by J. Totems and P. Chazette***

**Anonymous Referee #2**

Received and published: 27 October 2015

Totems and Chazette present an original calibration method for water vapour Raman lidar, using a meteorological probe on-board a kite. The advantage is that the probe can be used to profile the atmosphere up to ~400 m, repeatedly, above the lidar station, and that it can be much better co-located than radiosondes. The lidar measurements have been compared to several alternative sources of water vapour data, including traditional radiosondes, MODIS, AERONET, and ECMWF reanalyses. These comparisons proved that the method is sound.

The calibration method using a kite, presented by the authors, looks very promising, and I would suggest that the paper be accepted after some revision, after following the suggestions below. In particular, the context given is insufficient, some of the statistical intercomparison is unclear, and some better analysis could be done to highlight

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spatiotemporal variabilities. Moreover, the English language used may deserve some revision.

The AERONET measurements appear to show a -28% bias, compared to the other sources of data, and according to the authors such a bias had not been found before. I will look into the scientific literature on this particular point and discuss it with colleagues more knowledgeable than me on AERONET, and will possibly post an additional referee comment if I find anything relevant.

**\*MAJOR POINTS:\***

1) Introduction: add more context on the significance of water vapour and describe better the Hymex and Charmex campaigns. The text added after the first review seems insufficient to clarify the context to a reader. The advice of the previous review has been followed only partially.

2) P. 10587, L. 9. Please clarify in the article text if the uncertainty is instrumental (e.g. computed from propagation of measurement uncertainties) or an atmospheric variability during the 40 min of the sampling (e.g. a standard deviation). Actually, both contributions are relevant to this comparison, and they could both be plotted.

3) P. 10587, L. 19-20. It would be worth trying to use the instantaneous data. For example, shorten the lidar integration time (e.g. 5 min) and use, for each altitude, the measurement corresponding to the time for the radiosonde at that altitude. This could give insight on temporal variability (i.e. averaging over 40 min might not be the best way to do this).

4) P. 10589, L. 6. This excess RMSE is about 1-1.5 g/kg as per figure. This is comparable to the stated uncertainties. Please state this and comment. In Figure 5, add the lines of RMSE +/- the measurement error (as per comment below, RMSE is a difference, not an error).

5) The conclusions are a little weak. They need to be strengthened (as already high-

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lighted in the previous review).

6) Please have a general check on the English language throughout the paper.

\*MINOR POINTS:\*

7) Abstract, line 13: "relative mean" → "relative difference".

8) Abstract, lines 13 and 15: add the percent sign after 5 and 3.

9) Introduction: spell acronyms (MISTRALS, IHOP, COPS, BASIL, IGN).

10) P. 10580, L. 2. Indicate which body recommends the 0.4 g/kg uncertainty (e.g. WMO or other)

11) P. 10581, L. 11. Add 'lidar' before 'signal'.

12) Section 2. Add the ground-based humidity probe mentioned on P. 10590, L. 18

13) Section 2.2. You mention 4 channels for the lidar. The first channel is at 354.7, the second one at 387, and the third one at 407. The fourth channel is never described. The advice of the previous review to clarify this has not been followed.

14) P. 10582, L. 13: "system" → "receiver".

15) P. 10582, L. 18: add "range" after "dynamic".

16) P. 10583, L. 4: "N2O" → "H2O".

17) P. 10583, L. 8: indicate if this previous calibration had been obtained in daytime or nighttime.

18) P. 10583, L. 11: add "due to SNR" after "daytime".

19) Section 2.3. Discuss the probe on the kite BEFORE the radiosondes at Sant-Luis. Discuss also the radiosondes at Palma de Maiorca (mentioned at the top of P. 10587)

20) Section 2.3. Indicate the maximum height that can be reached with the kite in your

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current set-up. I assume that this is not the same as the cable length.

21) P. 10583, L. 26: "could be" → "were"

22) Equation 2. The transmission term has been neglected. Please state so in the text and justify.

23) P. 10586, L. 7. It looks that only the second flight could yield K-WVMR, as it was the only one reaching above overlap (see figure 3).

24) P. 10586, L. 11. Also indicate the distance of full overlap (~150 m).

25) P. 10587, L. 13. HYSPLIT does not give you the optical properties. This must be a typo.

26) P. 10588, L. 12. Indicate your profile truncation criteria at the far range (e.g. a threshold on SNR or standard deviation).

27) P. 10589, L. 1. The RMSE is actually a "RMS difference" between two types of measurements not exactly co-located. I think that calling it an "error" is inappropriate. Correct the term through out the paper (used several times).

28) P. 10589, L. 2. Add "coefficient" after "correlation".

29) P. 10589, L. 17. The local differences within the PBL should be mentioned as sources of this decorrelation.

30) The formula on L. 2 on P. 10589 and Equation 3 have not been rendered correctly.

31) P. 10591, L. 2. It is unclear which calibration factor is varying by 17%. It looks that your results show a much more stable calibration.

32) P. 10591, L. 4. The MODIS discrepancies do not seem as dramatic as the AERONET.

33) P. 10591, L. 17. Add "of AERONET" at the end of the line".

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34) P. 10592, L. 15. The word "not relevant" does not seem appropriate here. The fact is that they may be sampling a different airmass.

35) P. 10592, L. 26. It is unclear why you mention sounding errors here. Perhaps, you wish to refer to a lack of correlation due to spatiotemporal variability?

36) P. 10593, L. 4. You should also say that the kite allows one to characterise the overlap of the lidar.

37) P. 10593, L. 13. "better" → "worse"

38) P. 10593, L. 18 "excludes"; L. 19 "points" → "seems to exclude"; "to point"

39) P. 10594, L. 3: "may" → "could".

40) Figure 5 caption: remove "natural" before "variability".

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Interactive comment on Atmos. Meas. Tech. Discuss., 8, 10577, 2015.

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